

# IRRIGATION WATER CONVEYANCE HIGH-PRESSURE, UNDERGROUND, PLASTIC PIPELINE

(Feet)  
Code 430DD

Natural Resources Conservation Service  
Conservation Practice Standard

## I. Definition

A pipeline and appurtenances installed in an irrigation system.

## II. Purpose

To prevent erosion or loss of water quality or damage to the land, to make possible proper management of irrigation water, and to reduce water conveyance losses.

## III. Conditions Where Practice Applies

This standard applies to underground thermoplastic pipelines ranging from ½ inch to 27 inches in diameter that are closed to the atmosphere and that are subject to internal pressures of 80 lb/in<sup>2</sup> or greater.

Pipelines can be planned and located to serve as an integral part of an irrigation water distribution or conveyance system designed to facilitate the conservation use and management of the soil and water resources on a farm or group of farms.

## IV. Federal, State, and Local Laws

Irrigation pipelines shall comply with all federal, state and local laws, rules or regulations. The operator is responsible for securing required permits. This standard does not contain the text of federal, state or local laws governing irrigation pipelines.

## V. Criteria

### General Criteria Applicable to All Purposes

The water supply, water quality, and rate of irrigation delivery for the area served by the pipelines shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application method to be used.

Plastic pipelines shall be placed only in suitable soils where the bedding and backfill requirements can be fully met.

**Working pressure and flow velocity.** The minimum acceptable class of pipe shall be that having a pressure rating for water of 80 lb/in<sup>2</sup>.

The pipeline shall be designed to meet all service requirements without an operating pressure, including hydraulic transients, or static pressure at any point greater than the pressure rating of the pipe used at that point. As a safety factor against surge or water hammer, the working pressure should not exceed 72 percent of the pressure rating of the pipe, nor should the design flow velocity at system capacity exceed 5 ft/sec. If either of these limits is exceeded, special consideration must be given to the flow conditions; and measures must be taken to adequately protect the pipeline against surge.

**Capacity.** Capacity shall be sufficient to provide an adequate irrigation stream for the irrigation application methods or planned storage.

Design capacity of the pipeline conveyance or distribution system shall be based on one of the following:

1. Adequate to meet the moisture demands of all crops to be irrigated in the design area.
2. Sufficient to meet the requirements of selected irrigation events during critical crop growth periods when less than full irrigation is planned.
3. For special-purpose irrigation systems, sufficient to apply a stated amount of water to the design area in a specified net operating period.
4. Sufficient to meet the requirements for efficient application with the distribution system.

In computing the above capacity requirements, allowance must be made for reasonable water losses during application or use.

**Friction losses.** For design purposes, friction head losses shall be no less than those computed by the Hazen-Williams equation, using a roughness coefficient, C, equal to 150.

**Outlets.** Appurtenances to deliver water from the pipe system to the field, ditch, reservoir, storage, or surface pipe system are known as outlets. Outlets shall have adequate capacity to deliver the required flow to:

1. The hydraulic gradeline of a pipe or ditch.
2. A point at least 6 inches above the field surface.
3. The design surface elevation in a reservoir.
4. An individual sprinkler, lateral line, hydrant, or other device at the required operating pressure.

Outlets shall be designed to minimize erosion, physical damage, or deterioration caused by exposure.

**Check valves.** A check valve shall be installed between the pump discharge and the pipeline where backflow may occur.

**Pressure-relief valves.** A pressure-relief valve shall be installed between the pump discharge and the pipeline if excessive pressure can build up when all valves are closed. Pressure-relief valves shall be installed on the discharge side of the check valve where a reversal of flow may occur and at the end of the pipeline, if needed, to relieve surge at the end of the line.

Pressure-relief valves shall be no smaller than  $\frac{1}{4}$  inch nominal size for each inch of the pipeline diameter and shall be set to open at a pressure no greater than 5 lb/in<sup>2</sup> above the pressure rating of the pipe.

The pressure at which the valves start to open shall be marked on each pressure-relief valve. Adjustable pressure-relief valves shall be sealed or otherwise altered to prevent changing the adjustment from that marked on the valve.

Manufacturers of pressure-relief valves marketed for use under this standard shall provide capacity tables, based on performance tests, that give the discharge capacities of the valves at the maximum permissible pressure and differential pressure settings. Such tables shall be the basis for the design and acceptance of these valves.

**Air-release valves.** The three basic types of air-release valves for use on irrigation pipelines are described below:

- An air-release valve, a continuously acting valve that has a small venting orifice, generally

ranging between 1/16 and 3/8 inch in size. This valve releases pockets of air from the pipeline once the line is filled and under working pressure.

- An air-vent and vacuum-relief valve, which has a large venting orifice, exhausts large quantities of air from the pipeline during filling and allows air to reenter the line, preventing a vacuum from forming during emptying. It is not continuous-acting because it does not allow further escape of air at working pressure once the valve closes.
- A combination air valve is sometimes called a combination air-release and air-vacuum valve or combination air-vent and vacuum-relief valve. It is continuous-acting and combines the functions of both the air-release valve and the air-vent and vacuum-relief valve. Both valves are housed in one valve body.

If needed to provide positive means for air escape during filling and air entry while emptying, air-vent and vacuum-relief valves or combination air valves shall be installed at all summits, at the entrance, and at the end(s) of the pipeline. Such valves generally are needed at these locations if the line is truly closed to the atmosphere. However, they may not be needed if other features of the pipe system, such as permanently located sprinkler nozzles or other unclosed service outlets, adequately vent the particular location during filling and emptying operations.

The ratio of air-release valve diameter to pipe diameter for valves intended to release air when filling the pipe should not be less than 0.1. However, small-diameter valves may be used to limit water hammer pressures by controlling air release where control of filling velocities is questionable. Equivalent valve outlet diameters of less than 0.1 are permitted for continuously acting air-release valves. Adequate vacuum relief must be provided.

Air-release valves or combination air valves shall be used as needed to permit air to escape from the pipeline while the line is at working pressure. Small orifices of these types shall be sized according to the working pressure and venting requirements recommended by the valve manufacturer.

Manufacturers of air valves marketed for use under this standard shall provide dimensional data, which shall be the basis for selection and acceptance of these valves.

**Drainage.** Provisions shall be made for completely draining the pipeline if a hazard is imposed by freezing temperatures, drainage is recommended by the manufacturer of the pipe, or drainage of the line is specified for the job. If provisions for drainage are required, drainage outlets shall be located at all low places in the line. These outlets may drain into dry wells or to points of lower elevation. If drainage cannot be provided by gravity, provisions shall be made to empty the line by pumping or by other means.

**Flushing.** If provisions are needed for flushing the line free of sediment or other foreign material, a suitable valve shall be installed at the distal end of the pipeline.

**Thrust control.** Abrupt changes in pipeline grade, horizontal alignment, or reduction in pipe size normally require an anchor or thrust blocks to absorb any axial thrust of the pipeline. Thrust control may also be needed at the end of the pipeline and at in-line control valves.

Thrust blocks and anchors must be large enough to withstand the forces tending to move the pipe, including those of momentum and pressure as well as forces due to expansion and contraction.

The pipe manufacturer's recommendations for thrust control shall be followed. In the absence of the pipe manufacturer's requirements, the following equation must be used in designing thrust blocks:

$$A = [98HD^2]/B[\sin(a/2)]$$

Where:

- A = Area of thrust block required in ft<sup>2</sup>
- H = Maximum working pressure in feet
- D = Inside diameter of pipe in feet
- B = Allowable passive pressure of the soil in lb/ft<sup>2</sup>
- a = Deflection angle of pipe bend

Area of thrust blocks for dead ends and tees shall be 0.7 times the area of block required for a 90-degree pipe bend.

If adequate soil tests are not available, the passive soil pressure may be estimated from Table 1.

**Table 1 – Allowable Soil Bearing Pressure**

| Natural Soil Material                           | Depth of Cover to Center of Thrust Block |        |        |        |
|---|--|--------|--------|--------|
|   | 2 ft.                                    | 3 ft.  | 4 ft.  | 5 ft.  |
|   | lb/ft <sup>2</sup>                       |        |        |        |
| Sound bedrock                                   | 8,000                                    | 10,000 | 10,000 | 10,000 |
| Dense sand and gravel mixture (assumed Ø = 40°) | 1,200                                    | 1,800  | 2,400  | 3,000  |
| Dense fine to coarse sand (assumed Ø = 35°)     | 800                                      | 1,200  | 1,650  | 2,100  |
| Silt and clay mixture (assumed Ø = 25°)         | 500                                      | 700    | 950    | 1,200  |
| Soft clay and organic soils (assumed Ø = 10°)   | 200                                      | 300    | 400    | 500    |

**Materials.** All materials described and required in this standard shall meet or exceed the minimum requirements contained in the plans and specifications.

## VI. Considerations

Additional recommendations relating to design that may enhance the use of, or avoid problems with, this practice but are not required to ensure its basic conservation functions are as follows.

- A. If irrigation application methods (for example, trickle irrigation) have limiting working pressures, pressure-relief valves should be considered to ensure the pressure created in the pipeline does not exceed the allowable pressure.
- B. Chemigation valves (that is, double-seated check valves with air relief valve and low pressure drain) should be used on all pipelines in which fertilizer, pesticides, acids, or other chemicals are added to the water supply and where drainage may contaminate the mainline, water supply, or ground water.
- C. Where pipelines are to be drained, consideration should be given to disposal of drained water.
- D. Consideration should be given to the direction of water leaving an air valve or pressure-relief valve. If possible, the flow should be directed away from electrical equipment and hook-ups.

- E. Design processes should consider safety elements when installations are effected by utilities.

## **VII. Plans and Specifications**

Plans and specifications for constructing high-pressure underground plastic pipeline shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

## **VII. Operation and Maintenance**

An operation and maintenance (O&M) plan shall be developed for each pipeline system installed. The plan should document needed actions to ensure that practices perform adequately throughout their expected life.

## Irrigation Water Conveyance High-Pressure, Underground, Plastic Pipeline

### Specifications

#### Installation

**Minimum depth of cover.** Pipe shall be installed at sufficient depth below the ground surface to provide protection from hazards imposed by traffic crossings, farming operations, freezing temperatures, or soil cracking. The minimum depth of cover for pipe susceptible to any of these hazards shall be:

| Pipe Diameter<br>(inches) | Depth of<br>Cover<br>(inches) |
|---------------------------|-------------------------------|
| ½ through 2 ½             | 18                            |
| 3 through 5               | 24                            |
| 6 or more                 | 30                            |

In areas where the pipe will not be susceptible to freezing and vehicular or cultivation hazards and the soils do not crack appreciably when dry, the minimum depth of cover may be reduced to:

| Pipe Diameter<br>(inches) | Depth of<br>Cover<br>(inches) |
|---------------------------|-------------------------------|
| ½ through 1 ½             | 6                             |
| 2 through 3               | 12                            |
| 4 through 6               | 18                            |
| More than 6               | 24                            |

In cranberry bogs where the pipe is not susceptible to freezing and heavy equipment is never allowed, the minimum depth of cover may be 6 inches for a 6-inch diameter pipe and 12 inches for a larger pipe.

The minimum cover for polyethylene pipe is 6 inches but may be reduced to 2 inches where conditions warrant. The minimum cover for PVC pipe in cranberry bogs, where the pipe is to be protected from freezing after winter flooding, shall be 12 inches, if the winter flood equals or exceeds 12 inches. Where the winter flood is less than 12 inches, the top of the pipe shall be at least 24 inches below the water surface. Solvent-welded joints shall be used at all connections of PVC pipe where peat and muck exist in their normal layered pattern. Rubber gasket joints may be used following normal bedding procedures where coarse sand or cement layers exist.

At low places on the ground surface, extra fill may be placed over the pipeline to provide the minimum depth of cover. The top width of the fill shall then be

no less than 10 feet and the side slopes no steeper than 6:1. If extra protection is needed at vehicle crossings, encasement pipe or other approved methods may be used.

**Trench construction.** The trench at any point below the top of the pipe shall be only wide enough to permit the pipe to be easily placed and joined and to allow the initial backfill material to be uniformly placed under the haunches and along the side of the pipe. The maximum trench width shall be 36 inches greater than the diameter of the pipe. If the trench is precision excavated and has a semicircular bottom that closely fits the pipe, the width shall not exceed the outside diameter of the pipe by more than 10 percent.

The trench bottom shall be uniform so that the pipe lies on the bottom without bridging. Clods, rocks, and uneven spots that can damage the pipe or cause nonuniform support shall be removed.

If rocks, boulders, or any other material that can damage the pipe are encountered, the trench bottom shall be undercut a minimum of 4 inches below final grade and filled with bedding material consisting of sand or compacted fine-grained soils.

Pipelines having a diameter of 1/2 through 2 ½ inches that are to be placed in areas not subject to vehicular loads and in soils that do not crack appreciably when dry may be placed by using "plow-in" equipment instead of conventional trenching.

Provisions shall be made to insure safe working conditions where unstable soil, trench depth, or other conditions can be hazardous to personnel working in the trench.

**Placement.** Care shall be taken to prevent permanent distortion and damage when handling the pipe during unusually warm or cold weather. The pipe shall be allowed to come within a few degrees of the temperature it will have after it is completely covered before placing the backfill, other than that needed for shading, or before connecting the pipe to other facilities. The pipe shall be uniformly and continuously supported over its entire length on firm stable material. Blocking or mounding shall not be used to bring the pipe to final grade.

For pipe with bell joints, bell holes shall be excavated in the bedding material, as needed, to allow for unobstructed assembly of the joint and to permit the body of the pipe to be in contact with the bedding material throughout its length.

**Joints and connections.** All joints and connections shall be designed and constructed to withstand the

design maximum working pressure for the pipeline without leakage and to leave the inside of the line free of any obstruction that may tend to reduce its capacity below design requirements.

All fittings, such as couplings, reducers, bends, tees, and crosses, shall be installed according to the recommendations of the pipe manufacturer.

Fittings made of steel or other metals susceptible to corrosion shall be adequately protected by being wrapped with plastic tape or by being coated with a substance that has high corrosion-preventative qualities. If plastic tape is used, all surfaces shall be thoroughly cleaned and coated with a primer compatible with the tape before wrapping.

**Thrust blocks.** Thrust blocks must be formed against a solid hand-excavated trench wall undamaged by mechanical equipment. They shall be constructed of concrete, and the space between the pipe and trench wall shall be filled to the height of the outside diameter of the pipe or as specified by the manufacturer.

**Testing.** The pipeline shall be tested for pressure strength, leakage, and proper functioning. The tests may be performed before backfilling or anytime after the pipeline is ready for service.

Tests for pressure strength and leaks shall be accomplished by inspecting the pipeline and appurtenances while the maximum working pressure is maintained and all joints and connections are uncovered, or by observing normal operation of the pipeline after it is put into service. Partial backfills needed to hold the pipe in place during testing shall be placed as specified in "Initial Backfill." Any leaks shall be repaired and the system retested.

The pipeline shall be tested to insure that it functions properly at design capacity. At or below design capacity there shall be no objectionable flow conditions. Objectionable flow conditions shall include water hammer, continuing unsteady delivery of water, damage to the pipeline, or detrimental discharge from control valves.

**Initial backfill.** Hand, mechanical, or water packing methods may be used.

The initial backfill material shall be soil or sand that is free from rocks or stones larger than 1 inch in diameter. At the time of placement, the moisture content of the material shall be such that the required degree of compaction can be obtained with the backfill method to be used. The initial backfill material shall be placed so that the pipe will not be displaced, excessively deformed, or damaged.

If backfilling is done by hand or mechanical means, the initial fill shall be compacted firmly around and above the pipe as required to provide adequate lateral support to the pipe.

If the water packing method is used, the pipeline first shall be filled with water. The initial backfill before wetting shall be of sufficient depth to insure complete coverage of the pipe after consolidation. Water packing is accomplished by adding enough water to diked reaches of the trench to thoroughly saturate the initial backfill without excessive pooling. After the backfill is saturated, the pipeline shall remain full until after the final backfill is made. The wetted fill shall be allowed to dry until firm before beginning the final backfill.

**Final backfill.** The final backfill material shall be free of large rocks, frozen clods, and other debris greater than 3 inches in diameter. The material shall be placed and spread in approximately uniform layers so that there will be no unfilled spaces in the backfill and the backfill will be level with the natural ground or at the design grade required to provide the minimum depth of cover after settlement. Rolling equipment shall not be used to consolidate the final backfill until the specified minimum depth of cover has been placed.

All special backfilling requirements of the pipe manufacturer shall be met.

**Basis of acceptance.** The acceptability of the pipeline shall be determined by inspections to check compliance with all the provisions of this standard with respect to the design of the line, the pipe and pipe marking, the appurtenances, and the minimum installation requirements.

**Certifications and guarantee.** If requested by the NRCS State Conservation Engineer, a qualified testing laboratory must certify with supporting test results that the pipe meets the requirements specified in this standard. The seal of approval of a recognized laboratory on pipe bearing one of the ASTM designations listed in this standard may be accepted for this certification.

The installing contractor shall certify that the installation complies with the requirements of this standard. The contractor shall furnish a written guarantee that protects the owner against defective workmanship and materials for not less than 1 year. The certification identifies the manufacturer and markings of the pipe used.

## Materials

**Quality of plastic pipe.** The compound used in manufacturing the pipe shall meet the requirements of one of the following materials:

1. Polyvinyl chloride (PVC) as specified in ASTM-D-1784.

| Material         | Code Classification |
|------------------|---------------------|
| Type I, Grade 1  | 12454-B             |
| Type I, Grade 2  | 12454-C             |
| Type II, Grade 1 | 14333-D             |

2. Acrylonitrile-butadiene-styrene (ABS) as specified in ASTM-D-1788.

| Material         | Code Classification |
|------------------|---------------------|
| Type I, Grade 2  | 5-2-2               |
| Type I, Grade 3  | 3-5-5               |
| Type II, Grade 1 | 4-4-5               |

3. Polyethylene (PE) as specified in ASTM-D-1248.

| Material           | Code Classification |
|--------------------|---------------------|
| Grade P14, Class C | IC-P14              |
| Grade P23, Class C | IIC-P23             |
| Grade P33, Class C | IIIC-P33            |
| Grade P34, Class C | IVC-P34             |

The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign matter, or other defects. The pipe shall be as uniform in color, opacity, density, and other physical properties as is commercially practicable.

**Pipe requirements.** All pipe installed under this standard shall be pressure rated for water.

The relationship between standard dimension ratios, dimensions, hydrostatic design stresses, and pressure ratings shall be determined by one of the following formulas:

For PVC, ABS, and PE pipe with outside diameter controlled:

$$\frac{2S}{P} = \frac{D_o}{t} - 1 \quad \text{or} \quad \frac{2S}{P} = R - 1$$

For PE pipe with inside diameter controlled:

$$\frac{2S}{P} = \frac{D_i}{t} + 1 \quad \text{or} \quad \frac{2S}{P} = R + 1$$

Where:

- S = hydrostatic design stress, in lb/in<sup>2</sup>.
- P = pressure rating in lb/in<sup>2</sup>.
- D<sub>o</sub> = average outside diameter in inches.
- D<sub>i</sub> = average inside diameter in inches.
- t = minimum wall thickness in inches.
- R = standard thermoplastic pipe dimension ratio (SDR).

Hydrostatic design stresses for the plastic pipe material are given in Table 1.

Iron pipe size (IPS) (outside diameter same as that for iron pipe sizes) and I.D. controlled PE pipe manufactured, tested, and marked to meet one of the following ASTM specifications shall be acceptable under this standard. Water pressure ratings and pertinent dimensions for this pipe are given Tables in 3, 4, 5, 6, and 7.

| ASTM   | Standard specification for:  |
|--------|--|
| D-1785 | Polyvinyl chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120               |
| D-2241 | Polyvinyl chloride (PVC) Plastic Pipe, (SDR-PR)                                |
| D-2672 | Bell-End Polyvinyl chloride (PVC) Plastic Pipe                                 |
| D-2740 | Polyvinyl chloride (PVC) Plastic Tubing  |
| D-1527 | Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80        |
| D-2282 | Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)                    |
| D-2104 | Polyethylene (PE) Plastic Pipe, Schedule 40                                    |
| D-2239 | Polyethylene (PE) Plastic Pipe, (SDR-PR)                                       |
| D-2447 | Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, based on outside diameter |
| D-2737 | Polyethylene (PE) Plastic Tubing   |
| D-3035 | Polyethylene (PE) Plastic Pipe, (SDR-PR), based on controlled outside diameter |
| F-771  | Polyethylene (PE) Thermoplastic High Pressure Irrigation Pipeline Systems      |

Plastic irrigation pipe (PIP) shall meet the requirements of ASTM-D-2241 or of ASTM-D-2282 except that:

1. The outside diameters, wall thicknesses, and tolerances given in Table 2 shall apply.
2. The sustained pressure test shall not be required.
3. The burst pressure tests shall be performed according to the procedures listed in ASTM-D-2241 or D-2282 and shall meet the applicable requirements given in these ASTMs or those listed below for the standard dimension ratios (SDRs) currently not included in ASTM-D-2241 or D-2282.

Burst pressure requirements for water at 23°C (73.4°F) for PVC 1120 and PVC 1220 plastic pipe are:

| SDR | Minimum burst pressure <sup>1</sup><br>(lb/in <sup>2</sup> ) |
|-----|--|
| 51  | 260  |

<sup>1</sup> The design stress levels used to drive these test pressures are: PVC 1120-6, 400 lb/in<sup>2</sup>; PVC 1220-6, 400 lb/in<sup>2</sup>.

Burst pressure requirements for water at 23° C (73.4° F) for ABS plastic pipe are:

| SDR  | Minimum burst pressure <sup>1</sup><br>(lb/in <sup>2</sup> ) |          |
|------|--|----------|
|      | ABS 2112   | ABS 1316 |
| 32.5 | 420  | 380      |
| 41   | ---  | 300      |

<sup>1</sup> The fiber stresses used to drive these test pressures are: ABS 2112-6, 600 lb/in<sup>2</sup>; ABS 1316-6, 000 lb/in<sup>2</sup>. To simplify testing, minor adjustments have been made to keep the test pressures uniform.

**Markings.** Markings on the pipe shall include the following, which shall be spaced at intervals of not more than 5 feet:

1. Nominal pipe size (for example, 2 inches).
2. Type of plastic pipe material, by designation code (for example, PVC 1120).
3. Pressure rating, in lb/in<sup>2</sup>, for water at 23°C (73.4°F) (for example, 160 lb/in<sup>2</sup>).
4. Specification designation with which the pipe complies:

- a. For IPS-size pipe, the ASTM designation (for example, D-2241).

Pipe meeting one of the ASTM designations listed for IPS-size pipe and intended for the transport of potable water shall also be marked with the seal of a recognized laboratory making the evaluation for this purpose.

- b. For plastic irrigation pipe, the designation PIP.
5. Manufacturer's name (or trademark) and code.

**Fittings and couplers.** All fittings and couplers shall meet or exceed the same strength requirements as those of the pipe and shall be made of material that is recommended for use with the pipe.

Listed below are the ASTM standard specifications for fittings suitable for use with IPS-size pipe and inside diameter controlled PE pipe covered by this standard:

| ASTM   | Standard specification for:   |
|--------|---|
| D-2466 | Socket-type Polyvinyl chloride (PVC) Plastic Pipe, Schedule 40                                    |
| D-2467 | Socket-type Polyvinyl chloride (PVC) Plastic Pipe, Schedule 80                                    |
| D-2468 | Socket-type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Fittings, Schedule 40                   |
| D-2609 | Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe  |
| D-2683 | Socket-type Polyethylene Fittings for SDR 11.0 Polyethylene Pipe                                  |
| D-3139 | Standard Specification for Plastic Pressure Pipe using Flexible Elastomeric Seals                 |
| D-3261 | Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing |

Plastic irrigation pipe (PIP) shall have belled ends or separate couplers and fittings that are suitable for joining the pipe and appurtenances by solvent cement, rubber gaskets, or other methods recommended by the pipe manufacturer. Such fittings and joints shall be capable of withstanding a working pressure equal to or greater than that for the pipe.

**Solvent cement joints.** Solvent for solvent cement joints shall conform to ASTM Specification D-2564 for PVC pipe and fittings and to D-2235 for ABS

pipe and fittings.

Solvent cement joints shall be used and constructed according to the recommendations of the pipe manufacturer.

**Rubber gasket joints.** Rubber gasket joints shall conform to ASTM Specification D-3139.

**Table 1.**  
**Hydrostatic Design Stress and Designation -**  
**Plastic Pipe**

| <b>Plastic Pipe Material</b> | <b>Hydrostatic Design Stress (lb/in<sup>2</sup>)</b> | <b>Designation</b> |
|------------------------------|--|--------------------|
| PVC Type I, Grade 1          | 2,000  | PVC 1120           |
| PVC Type I, Grade 2          | 2,000  | PVC 1220           |
| PVC Type II, Grade 1         | 1,000  | PVC 2110           |
| PVC Type II, Grade 1         | 1,250  | PVC 2112           |
| PVC Type II, Grade 1         | 1,600  | PVC 2116           |
| ABS Type I, Grade 2          | 800  | ABS 1208           |
| ABS Type I, Grade 2          | 1,000  | ABS 1210           |
| ABS Type I, Grade 3          | 1,600  | ABS 1316           |
| ABS Type II, Grade 1         | 1,250  | ABS 2112           |
| PE Grade P14                 | 400  | PE 1404            |
| PE Grade P23                 | 500  | PE 2305            |
| PE Grade P23                 | 630  | PE 2306            |
| PE Grade P33                 | 630  | PE 3306            |
| PE Grade P34                 | 630  | PE 3406            |
| PE Grade P34                 | 800  | PE 3408            |

**Table 2**  
**PVC and ABS Plastic Irrigation Pipe (PIP)**  
**(Nonthreaded)**

| Nominal<br>Pipe<br>Size (in) | SDR  | PVC Pressure Rating<br>(lb/in <sup>2</sup> ) |      |      |      | Dimension and Tolerance |                   |                  |                   |             | ABS Pressure Rating<br>(lb/in <sup>2</sup> ) |      |      |
|------------------------------|------|--|------|------|------|-------------------------|-------------------|------------------|-------------------|-------------|--|------|------|
|                              |      | Material                                     |      |      |      | Wall Thickness          |                   | Outside Diameter |                   | ± Tolerance | Material                                     |      |      |
|                              |      | 1120   | 2116 | 2112 | 2110 | Min<br>(in)             | Tolerance<br>(in) | Average<br>(in)  | Avg. O.D.<br>(in) |             | 1316   | 2112 | 1210 |
| 4                            | 51   | 80   |      |      |      | .081                    | +0.020            | 4.130            | 0.009             | 0.050       |  |      |      |
|                              | 41   | 100  | 80   |      |      | .101                    | +0.020            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .127                    | +0.020            |                  |                   |             | 100  | 80   |      |
|                              | 26   | 160  | 125  | 100  | 80   | .159                    | +0.020            |                  |                   |             | 125  | 100  | 80   |
| 6                            | 51   | 80   |      |      |      | .120                    | +0.20             | 6.140            | .011              | .050        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .150                    | +0.020            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .189                    | +0.023            |                  |                   |             | 100  | 80   |      |
|                              | 26   | 160  | 125  | 100  | 80   | .236                    | +0.028            |                  |                   |             | 125  | 100  | 80   |
| 8                            | 51   | 80   |      |      |      | .160                    | +0.020            | 8.160            | .015              | .070        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .199                    | +0.024            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .251                    | +0.031            |                  |                   |             | 100  | 80   |      |
|                              | 26   | 160  | 125  | 100  | 80   | .314                    | +0.038            |                  |                   |             | 125  | 100  | 80   |
| 10                           | 51   | 80   |      |      |      | .200                    | +0.024            | 10.200           | .015              | .075        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .249                    | +0.030            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .314                    | +0.038            |                  |                   |             | 100  | 80   |      |
|                              | 26   | 160  | 125  | 100  | 80   | .392                    | +0.047            |                  |                   |             | 125  | 100  | 80   |
| 12                           | 51   | 80   |      |      |      | .240                    | +0.029            | 12.240           | .015              | .075        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .299                    | +0.036            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .377                    | +0.045            |                  |                   |             | 100  | 80   |      |
|                              | 26   | 160  | 125  | 100  | 80   | .471                    | +0.056            |                  |                   |             | 125  | 100  | 80   |
| 14                           | 51   | 80   |      |      |      | .280                    | +0.034            | 14.280           | .021              | .075        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .348                    | +0.042            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .439                    | +0.053            |                  |                   |             | 100  | 80   |      |
|                              | 26   | 160  | 125  | 100  | 80   | .549                    | +0.066            |                  |                   |             | 125  | 100  | 80   |
| 15                           | 51   | 80   |      |      |      | .300                    | +0.036            | 15.300           | .023              | .075        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .373                    | +0.045            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .471                    | +0.057            |                  |                   |             | 100  | 80   |      |
|                              | 26   | 160  | 125  | 100  | 80   | .588                    | +0.071            |                  |                   |             | 125  | 100  | 80   |
| 16                           | 51   | 80   |      |      |      | .314                    | +0.038            | 16.314           | .024              | .075        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .390                    | +0.047            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .492                    | +0.059            |                  |                   |             | 100  | 80   |      |
|                              | 26   | 160  | 125  | 100  | 80   | .615                    | +0.074            |                  |                   |             | 125  | 100  | 80   |
| 18                           | 51   | 80   |      |      |      | .367                    | +0.044            | 18.367           | .027              | .100        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .456                    | +0.127            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .575                    | +0.069            |                  |                   |             | 100  | 80   |      |
| 21                           | 51   | 80   |      |      |      | .432                    | +0.05             | 21.432           | .033              | .100        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .538                    | +0.15             |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .678                    | +0.081            |                  |                   |             | 100  | 80   |      |
| 24                           | 51   | 80   |      |      |      | .486                    | +0.058            | 24.486           | .036              | .125        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .605                    | +0.169            |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .763                    | +0.092            |                  |                   |             | 100  | 80   |      |
| 27                           | 51   | 80   |      |      |      | .548                    | +0.066            | 27.548           | .047              | .125        |  |      |      |
|                              | 41   | 100  | 80   |      |      | .682                    | +0.19             |                  |                   |             | 80   |      |      |
|                              | 32.5 | 125  | 100  | 80   |      | .860                    | +0.103            |                  |                   |             | 100  | 80   |      |

**Table 3**  
**PVC and ABS Thermoplastic Pipe (SDR-PR) – (IPS)**  
**(Nonthreaded)**

| (PVC-ASTM-D-2241)            |      |  |      |             |                   |                         |                   |                   |             | (ABS-ASTM-D-2282) |  |      |     |     |  |
|------------------------------|------|--|------|-------------|-------------------|-------------------------|-------------------|-------------------|-------------|-------------------|--|------|-----|-----|--|
| Nominal<br>Pipe<br>Size (in) | SDR  | PVC Pressure Rating<br>(lb/in <sup>2</sup> ) |      |             |                   | Dimension and Tolerance |                   |                   |             |                   | ABS Pressure Rating<br>(lb/in <sup>2</sup> ) |      |     |     |  |
|                              |      |  |      |             |                   | Wall Thickness          |                   | Outside Diameter  |             |                   |  |      |     |     |  |
|                              |      | Material                                     |      |             |                   | Min<br>(in)             | Tolerance<br>(in) | Average<br>(in)   | ± Tolerance |                   | Material                                     |      |     |     |  |
| 1120<br>1220                 | 2116 | 2112   | 2110 | Min<br>(in) | Tolerance<br>(in) | Average<br>(in)         | Avg. O.D.<br>(in) | Max & Min<br>(in) | 1316        | 2112              | 1210   | 1208 |     |     |  |
| ½                            | 17   |  |      |             |                   | 0.060                   | +0.020            | 0.804             | 0.004       | 0.008             | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .062                    | +.020             |                   |             | .008              | 250  | 200  | 160 | 125 |  |
| ¾                            | 21   | 200  | 160  | 125         | 100               | .060                    | +.020             | 1.050             | .004        | .015              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .062                    | +.020             |                   |             | .010              | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .078                    | +.020             |                   |             | .010              | 250  | 200  | 160 | 125 |  |
| 1                            | 26   | 160  | 125  | 100         | 80                | .060                    | +.020             | 1.315             | .005        | .015              | 125  | 100  | 80  |     |  |
|                              | 21   | 200  | 160  | 125         | 100               | .063                    | +.020             |                   |             | .015              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .077                    | +.020             |                   |             | .010              | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .097                    | +.020             |                   |             | .010              | 250  | 200  | 160 | 125 |  |
| 1 ¼                          | 32.5 | 125  | 100  | 80          |                   | .060                    | +.020             | 1.660             | 0.55        | .015              | 100  | 80   |     |     |  |
|                              | 26   | 160  | 125  | 100         | 80                | .064                    | +.020             |                   |             | .015              | 125  | 100  | 80  |     |  |
|                              | 21   | 200  | 160  | 125         | 100               | .079                    | +.020             |                   |             | .015              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .098                    | +.020             |                   |             | .012              | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .123                    | +.020             |                   |             | .012              | 250  | 200  | 160 | 125 |  |
| 1 ½                          | 32.5 | 125  | 100  | 80          |                   | .060                    | +.020             | 1.900             | .006        | .030              | 100  | 80   |     |     |  |
|                              | 26   | 160  | 125  | 100         | 80                | .073                    | +.020             |                   |             | .030              | 125  | 100  | 80  |     |  |
|                              | 21   | 200  | 160  | 125         | 100               | .090                    | +.020             |                   |             | .030              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .112                    | +.020             |                   |             | .012              | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .141                    | +.020             |                   |             | .012              | 250  | 200  | 160 | 125 |  |
| 2                            | 32.5 | 125  | 100  | 80          |                   | .060                    | +.020             | 2.375             | .006        | .030              | 100  | 80   |     |     |  |
|                              | 26   | 160  | 125  | 100         | 80                | .091                    | +.020             |                   |             | .030              | 125  | 100  | 80  |     |  |
|                              | 21   | 200  | 160  | 125         | 100               | .113                    | +.020             |                   |             | .030              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .140                    | +.020             |                   |             | .012              | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .176                    | +.021             |                   |             | .012              | 250  | 200  | 160 | 125 |  |
| 2 ½                          | 32.5 | 125  | 100  | 80          |                   | .083                    | +.020             | 2.875             | .007        | .030              | 100  | 80   |     |     |  |
|                              | 26   | 160  | 125  | 100         | 80                | .110                    | +.020             |                   |             | .030              | 125  | 100  | 80  |     |  |
|                              | 21   | 200  | 160  | 125         | 100               | .137                    | +.020             |                   |             | .030              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .169                    | +.020             |                   |             | .015              | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .213                    | +.026             |                   |             | .015              | 250  | 200  | 160 | 125 |  |
| 3                            | 32.5 | 125  | 100  | 80          |                   | .108                    | +.020             | 3.500             | .008        | .030              |  |      |     |     |  |
|                              | 26   | 160  | 125  | 100         | 80                | .135                    | +.020             |                   |             | .030              | 125  | 100  | 80  |     |  |
|                              | 21   | 200  | 160  | 125         | 100               | .167                    | +.020             |                   |             | .030              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .206                    | +.025             |                   |             | .015              | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .259                    | +.031             |                   |             | .015              | 250  | 200  | 160 | 125 |  |
| 3 ½                          | 41   | 100  | 80   |             |                   | .098                    | +.020             | 4.000             | .008        | .050              |  |      |     |     |  |
|                              | 32.5 | 125  | 100  | 80          |                   | .123                    | +.020             |                   |             | .050              |  |      |     |     |  |
|                              | 26   | 160  | 125  | 100         | 80                | .154                    | +.020             |                   |             | .050              | 125  | 100  | 80  |     |  |
|                              | 21   | 200  | 160  | 125         | 100               | .190                    | +.023             |                   |             | .050              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .235                    | +.028             |                   |             | .015              | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .296                    | +.036             |                   |             | .015              | 250  | 200  | 160 | 125 |  |
| 4                            | 41   | 100  | 80   |             |                   | .110                    | +.020             | 4.500             | .009        | .050              |  |      |     |     |  |
|                              | 32.5 | 125  | 100  | 80          |                   | .138                    | +.020             |                   |             | .050              |  |      |     |     |  |
|                              | 26   | 160  | 125  | 100         | 80                | .173                    | +.021             |                   |             | .050              | 125  | 100  | 80  |     |  |
|                              | 21   | 200  | 160  | 125         | 100               | .214                    | +.026             |                   |             | .050              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .265                    | +.032             |                   |             | .015              | 200  | 160  | 125 | 100 |  |
| 13.5                         | 315  | 250  | 200  | 160         | .333              | +.040                   | .015              | 250               | 200         | 160               | 125  |      |     |     |  |
| 5                            | 41   | 100  | 80   |             |                   | .136                    | +.020             | 5.563             | .010        | .050              |  |      |     |     |  |
|                              | 32.5 | 125  | 100  | 80          |                   | .171                    | +.021             |                   |             | .050              |  |      |     |     |  |
|                              | 26   | 160  | 125  | 100         | 80                | .214                    | +.027             |                   |             | .050              | 125  | 100  | 80  |     |  |
|                              | 21   | 200  | 160  | 125         | 100               | .265                    | +.032             |                   |             | .050              | 160  | 125  | 100 | 80  |  |
|                              | 17   | 250  | 200  | 160         | 125               | .327                    | +.039             |                   |             | .030              | 200  | 160  | 125 | 100 |  |
|                              | 13.5 | 315  | 250  | 200         | 160               | .412                    | +.049             |                   |             | .030              | 250  | 200  | 160 | 125 |  |

| (PVC-ASTM-D-2241)            |      |  |      |     |     |                         |                   | (ABS-ASTM-D-2282) |             |      |  |      |     |     |
|------------------------------|------|--|------|-----|-----|-------------------------|-------------------|-------------------|-------------|------|--|------|-----|-----|
| Nominal<br>Pipe<br>Size (in) | SDR  | PVC Pressure Rating<br>(lb/in <sup>2</sup> ) |      |     |     | Dimension and Tolerance |                   |                   |             |      | ABS Pressure Rating<br>(lb/in <sup>2</sup> ) |      |     |     |
|                              |      |  |      |     |     | Wall Thickness          |                   | Outside Diameter  |             |      |  |      |     |     |
|                              |      | Material                                     |      |     |     | Min<br>(in)             | Tolerance<br>(in) | Average<br>(in)   | ± Tolerance |      | Material                                     |      |     |     |
| 1120<br>1220                 | 2116 | 2112   | 2110 |     |     |                         | Avg. O.D.<br>(in) | Max & Min<br>(in) | 1316        | 2112 | 1210   | 1208 |     |     |
| 6                            | 41   | 100  | 80   |     |     | .162                    | + .020            | 6.625             | .015        | .050 |  |      |     |     |
|                              | 32.5 | 125  | 100  | 80  |     | .204                    | + .024            |                   |             | .050 |  |      |     |     |
|                              | 26   | 160  | 125  | 100 | 80  | .255                    | + .031            |                   |             | .050 | 125  | 100  | 80  |     |
|                              | 21   | 200  | 160  | 125 | 100 | .316                    | + .038            |                   |             | .050 | 160  | 125  | 100 | 80  |
|                              | 17   | 250  | 200  | 160 | 125 | .390                    | + .047            |                   |             | .035 | 200  | 160  | 125 | 100 |
|                              | 13.5 | 315  | 250  | 200 | 160 | .491                    | + .059            |                   |             | .035 | 250  | 200  | 160 | 125 |
| 8                            | 41   | 100  | 80   |     |     | .210                    | + .025            | 8.625             | .015        | .075 |  |      |     |     |
|                              | 32.5 | 125  | 100  | 80  |     | .265                    | + .032            |                   |             | .075 |  |      |     |     |
|                              | 26   | 160  | 125  | 100 | 80  | .332                    | + .040            |                   |             | .075 | 125  | 100  | 80  |     |
|                              | 21   | 200  | 160  | 125 | 100 | .410                    | + .049            |                   |             | .075 | 160  | 125  | 100 | 80  |
|                              | 17   | 250  | 200  | 160 | 125 | .508                    | + .061            |                   |             | .045 |  |      |     |     |
|                              |      |  |      |     |     |                         |                   |                   |             |      |  |      |     |     |
| 10                           | 41   | 100  | 80   |     |     | .262                    | + .031            | 10.750            | .015        | .075 |  |      |     |     |
|                              | 32.5 | 125  | 100  | 80  |     | .331                    | + .040            |                   |             | .075 |  |      |     |     |
|                              | 26   | 160  | 125  | 100 | 80  | .413                    | + .050            |                   |             | .075 | 125  | 100  | 80  |     |
|                              | 21   | 200  | 160  | 125 | 100 | .511                    | + .061            |                   |             | .075 | 160  | 125  | 100 | 80  |
|                              | 17   | 250  | 200  | 160 | 125 | .632                    | + .076            |                   |             | .050 |  |      |     |     |
|                              |      |  |      |     |     |                         |                   |                   |             |      |  |      |     |     |
| 12                           | 41   | 100  | 80   |     |     | .311                    | + .037            | 12.750            | .015        | .075 |  |      |     |     |
|                              | 32.5 | 125  | 100  | 80  |     | .392                    | + .047            |                   |             | .075 |  |      |     |     |
|                              | 26   | 160  | 125  | 100 | 80  | .490                    | + .059            |                   |             | .075 | 125  | 100  | 80  | 63  |
|                              | 21   | 200  | 160  | 125 | 100 | .606                    | + .073            |                   |             | .075 | 160  | 125  | 100 | 80  |
|                              | 17   | 250  | 200  | 160 | 125 | .750                    | + .090            |                   |             | .060 |  |      |     |     |
|                              |      |  |      |     |     |                         |                   |                   |             |      |  |      |     |     |
| 16                           | 41   | 100  | 80   |     |     | .389                    | + .047            | 16.00             | .019        | .160 |  |      |     |     |
|                              | 32.5 | 125  | 100  | 80  |     | .492                    | + .059            |                   |             | .160 |  |      |     |     |
|                              | 26   | 160  | 125  | 100 | 80  | .615                    | + .074            |                   |             | .160 | 125  | 100  | 80  |     |
| 18                           | 41   | 100  | 80   |     |     | .439                    | + .061            | 18.36             | .019        | .180 |  |      |     |     |
|                              | 32.5 | 125  | 100  | 80  |     | .554                    | + .066            |                   |             | .180 |  |      |     |     |
|                              | 26   | 160  | 125  | 100 | 80  | .692                    | + .083            |                   |             | .180 | 125  | 100  | 80  |     |
| 20                           | 41   | 100  | 80   |     |     | .488                    | + .068            | 20.40             | .023        | .200 |  |      |     |     |
|                              | 32.5 | 125  | 100  | 80  |     | .615                    | + .074            |                   |             | .200 |  |      |     |     |
|                              | 26   | 160  | 125  | 100 | 80  | .769                    | + .092            |                   |             | .200 | 125  | 100  | 80  |     |
| 24                           | 41   | 100  | 80   |     |     | .585                    | + .082            | 24.00             | .031        | .240 |  |      |     |     |
|                              | 32.5 | 125  | 100  | 80  |     | .738                    | + .088            |                   |             | .240 |  |      |     |     |
|                              | 26   | 160  | 125  | 100 | 80  | .923                    | + .111            |                   |             | .240 | 125  | 100  | 80  |     |

**Table 4**  
**Polyethylene Plastic Pipe (SDR-PR) – I.D. Controlled**  
**(Nonthreaded)**

(PE-ASTM-D-2239)

| Nominal<br>Pipe<br>Size (in) | SDR  | PVC Pressure Rating<br>(lb/in <sup>2</sup> ) |      |      | Wall Thickness |                        | Inside Diameter |           |       |
|------------------------------|------|--|------|------|----------------|------------------------|-----------------|-----------|-------|
|                              |      | Material <sup>1</sup>                        |      |      |                |                        | (in)            | Tolerance |       |
|                              |      | 3306<br>3406<br>2306                         | 2305 | 1404 | Min<br>(in)    | Tolerance<br>+<br>(in) |                 | +         | -     |
|                              |      |  |      |      |                |                        |                 | (in)      | (in)  |
| ½                            | 15   | 80   |      |      | 0.060          | 0.020                  | 0.622           | 0.010     | 0.010 |
|                              | 11.5 | 100  | 80   |      | .060           | .020                   |                 |           |       |
|                              | 9    | 125  | 100  | 80   | .069           | .020                   |                 |           |       |
|                              | 7    | 160  | 125  | 100  | .089           | .020                   |                 |           |       |
|                              | 5.3  | 200  | 160  | 125  | .117           | .020                   |                 |           |       |
| ¾                            | 15   | 80   |      |      | .060           | .020                   | .824            | .010      | .015  |
|                              | 11.5 | 100  | 80   |      | .072           | .020                   |                 |           |       |
|                              | 9    | 125  | 100  | 80   | .092           | .020                   |                 |           |       |
|                              | 7    | 160  | 125  | 100  | .118           | .020                   |                 |           |       |
|                              | 5.3  | 200  | 160  | 125  | .155           | .020                   |                 |           |       |
| 1                            | 15   | 80   |      |      | .070           | .020                   | 1.049           | .010      | .020  |
|                              | 11.5 | 100  | 80   |      | .091           | .020                   |                 |           |       |
|                              | 9    | 125  | 100  | 80   | .117           | .020                   |                 |           |       |
|                              | 7    | 160  | 125  | 100  | .150           | .020                   |                 |           |       |
|                              | 5.3  | 200  | 160  | 125  | .198           | .024                   |                 |           |       |
| 1 ¼                          | 15   | 80   |      |      | .092           | .020                   | 1.380           | .010      | .020  |
|                              | 11.5 | 100  | 80   |      | .120           | .020                   |                 |           |       |
|                              | 9    | 125  | 100  | 80   | .153           | .020                   |                 |           |       |
|                              | 7    | 160  | 125  | 100  | .197           | .024                   |                 |           |       |
|                              | 5.3  | 200  | 160  | 125  | .260           | .031                   |                 |           |       |
| 1 ½                          | 15   | 80   |      |      | .107           | .020                   | 1.610           | .015      | .020  |
|                              | 11.5 | 100  | 80   |      | .140           | .020                   |                 |           |       |
|                              | 9    | 125  | 100  | 80   | .179           | .020                   |                 |           |       |
|                              | 7    | 160  | 125  | 100  | .230           | .028                   |                 |           |       |
|                              | 5.3  | 200  | 160  | 125  | .304           | .036                   |                 |           |       |
| 2                            | 15   | 80   |      |      | .138           | .020                   | 2.067           | .015      | .020  |
|                              | 11.5 | 100  | 80   |      | .180           | .022                   |                 |           |       |
|                              | 9    | 125  | 100  | 80   | .230           | .028                   |                 |           |       |
|                              | 7    | 160  | 125  | 100  | .295           | .035                   |                 |           |       |
|                              | 5.3  | 200  | 160  | 125  | .390           | .047                   |                 |           |       |
| 2 ½                          | 15   | 80   |      |      | .165           | .020                   | 2.469           | .015      | .025  |
|                              | 11.5 | 100  | 80   |      | .215           | .025                   |                 |           |       |
| 3                            | 15   | 80   |      |      | .205           | .020                   | 3.068           | .015      | .030  |
|                              | 11.5 | 100  | 80   |      | .267           | .032                   |                 |           |       |
| 4                            | 15   | 80   |      |      | .268           | .032                   | 4.026           | .015      | .035  |
|                              | 11.5 | 100  | 80   |      | .350           | .042                   |                 |           |       |
| 6                            | 15   | 80   |      |      | .404           | .048                   | 6.065           | .020      | .035  |
|                              | 11.5 | 100  | 80   |      | .527           | .063                   |                 |           |       |

<sup>1</sup> For the material PE 3408, the SDRs are 5.3, 7.0, 9.0, and 15.0 and their respective pressure ratings (lb/in<sup>2</sup>) are 250, 200, 160, and 100.

**Table 5**  
**Polyethylene Plastic Pipe (SDR-PR) – O.D. Controlled (IPS)**  
**(Nonthreaded)**

(PE-ASTM-D-3035)

| Nominal<br>Pipe<br>Size (in) | SDR  | PVC Pressure Rating<br>(lb/in <sup>2</sup> ) |      |      | Wall Thickness |                        | Inside Diameter |           |       |
|------------------------------|------|--|------|------|----------------|------------------------|-----------------|-----------|-------|
|                              |      | Material <sup>1</sup>                        |      |      | Min<br>(in)    | Tolerance<br>+<br>(in) | (in)            | Tolerance |       |
|                              |      | 3306<br>3406<br>2306                         | 2305 | 1404 |                |                        |                 | +         | –     |
|                              |      |  |      |      |                |                        |                 | (in)      | (in)  |
| ½                            | 17   | 80   |      |      | 0.062          | 0.020                  | 0.840           | 0.004     | 0.004 |
|                              | 13.5 | 100  | 80   |      | .062           | .020                   |                 |           |       |
|                              | 11   | 125  | 100  | 80   | .076           | .020                   |                 |           |       |
| ¾                            | 17   | 80   |      |      | .062           | .020                   | 1.050           | .004      | .004  |
|                              | 13.5 | 100  | 80   |      | .078           | .020                   |                 |           |       |
|                              | 11   | 125  | 100  | 80   | .095           | .021                   |                 |           |       |
| 1                            | 17   | 80   |      |      | .077           | .020                   | 1.315           | .005      | .005  |
|                              | 13.5 | 100  | 80   |      | .097           | .020                   |                 |           |       |
|                              | 11   | 125  | 100  | 80   | .119           | .026                   |                 |           |       |
| 1 ¼                          | 17   | 80   |      |      | .098           | .020                   | 1.660           | .005      | .005  |
|                              | 13.5 | 100  | 80   |      | .123           | .020                   |                 |           |       |
|                              | 11   | 125  | 100  | 80   | .151           | .026                   |                 |           |       |
| 1 ½                          | 17   | 80   |      |      | .112           | .020                   | 1.900           | .006      | .006  |
|                              | 13.5 | 100  | 80   |      | .141           | .020                   |                 |           |       |
|                              | 11   | 125  | 100  | 80   | .173           | .026                   |                 |           |       |
| 2                            | 17   | 80   |      |      | .140           | .020                   | 2.375           | .006      | .006  |
|                              | 13.5 | 100  | 80   |      | .176           | .021                   |                 |           |       |
|                              | 11   | 125  | 100  | 80   | .216           | .026                   |                 |           |       |
| 3                            | 17   | 80   |      |      | .206           | .025                   | 3.500           | .008      | .008  |
|                              | 13.5 | 100  | 80   |      | .259           | .031                   |                 |           |       |
|                              | 11   | 125  | 100  | 80   | .318           | .038                   |                 |           |       |
| 4                            | 17   | 80   |      |      | .264           | .032                   | 4.500           | .009      | .009  |
|                              | 13.5 | 100  | 80   |      | .333           | .040                   |                 |           |       |
|                              | 11   | 125  | 100  | 80   | .409           | .049                   |                 |           |       |
| 6                            | 17   | 80   |      |      | .390           | .047                   | 6.625           | .011      | .011  |
|                              | 13.5 | 100  | 80   |      | .491           | .059                   |                 |           |       |
|                              | 11   | 125  | 100  | 80   | .602           | .072                   |                 |           |       |

<sup>1</sup> For the material PE 3408, the SDRs are 11, 13.5, 17, and 21 and their respective pressure ratings (lb/in<sup>2</sup>) are 160, 125, 100, and 80.

**Table 6a**  
**Water Pressure Ratings for Schedules 40 and 80 Unthreaded Plastic Pipe: Polyvinyl Chloride**

| Nominal Size (in) | Average Inside Diameter (in) |         | (PVC-ASTM-D-1785 Schedule 40 and 80 Pipe)<br>Working Pressure Rating (lb/in <sup>2</sup> ) |         |          |         |          |         |          |         |
|-------------------|------------------------------|---------|--|---------|----------|---------|----------|---------|----------|---------|
|                   |                              |         | PVC 1120 1220  |         | PVC 2116 |         | PVC 2112 |         | PVC 2110 |         |
|                   | Sch. 40                      | Sch. 80 | Sch. 40  | Sch. 80 | Sch. 40  | Sch. 80 | Sch. 40  | Sch. 80 | Sch. 40  | Sch. 80 |
| ½                 | 0.622                        | 0.546   | 600  | 850     | 480      | 680     | 370      | 530     | 300      | 420     |
| ¾                 | .824                         | .742    | 480  | 690     | 390      | 550     | 300      | 430     | 240      | 340     |
| 1                 | 1.049                        | .957    | 450  | 630     | 360      | 500     | 280      | 390     | 220      | 320     |
| 1 ¼               | 1.380                        | 1.278   | 370  | 520     | 290      | 420     | 230      | 320     | 180      | 260     |
| 1 ½               | 1.610                        | 1.500   | 330  | 470     | 260      | 380     | 210      | 290     | 170      | 240     |
| 2                 | 2.067                        | 1.939   | 280  | 400     | 220      | 320     | 170      | 250     | 140      | 200     |
| 2 ½               | 2.469                        | 2.323   | 300  | 420     | 240      | 340     | 190      | 260     | 150      | 210     |
| 3                 | 3.068                        | 2.900   | 260  | 370     | 210      | 300     | 160      | 230     | 130      | 190     |
| 3 ½               | 3.548                        | 3.364   | 240  | 350     | 190      | 280     | 150      | 220     | 120      | 170     |
| 4                 | 4.026                        | 3.826   | 220  | 320     | 180      | 260     | 140      | 200     | 110      | 160     |
| 5                 | 5.047                        | 4.813   | 190  | 290     | 160      | 230     | 120      | 180     | 100      | 140     |
| 6                 | 6.065                        | 5.761   | 180  | 280     | 140      | 220     | 110      | 170     | 90       | 140     |
| 8                 | 7.981                        | 7.625   | 160  | 250     | 120      | 200     | 100      | 150     | 80       | 120     |
| 10                | 10.020                       | 9.564   | 140  | 230     | 110      | 190     | 90       | 150     |          | 120     |
| 12                | 11.938                       | 11.376  | 130  | 230     | 110      | 180     | 80       | 140     |          | 110     |

**Table 6b**  
**Water Pressure Ratings for Schedules 40 and 80 Unthreaded Plastic Pipe: Acrylonitrile-Butadiene-Styrene**

| Nominal Size (in) | Average Inside Diameter (in) |         | (ABS-ASTM-D-1527 Schedule 40 and 80 Pipe)<br>Working Pressure Rating (lb/in <sup>2</sup> ) |         |          |         |          |         |          |         |
|-------------------|------------------------------|---------|--|---------|----------|---------|----------|---------|----------|---------|
|                   |                              |         | ABS 1316   |         | ABS 2112 |         | ABS 1210 |         | ABS 1208 |         |
|                   | Sch. 40                      | Sch. 80 | Sch. 40  | Sch. 80 | Sch. 40  | Sch. 80 | Sch. 40  | Sch. 80 | Sch. 40  | Sch. 80 |
| ½                 | 0.622                        | 0.546   | 430  | 680     | 370      | 530     | 300      | 420     | 240      | 340     |
| ¾                 | .824                         | .742    | 390  | 550     | 300      | 430     | 240      | 340     | 190      | 280     |
| 1                 | 1.049                        | .957    | 360  | 500     | 280      | 390     | 220      | 320     | 180      | 250     |
| 1 ¼               | 1.380                        | 1.278   | 290  | 420     | 230      | 330     | 180      | 260     | 150      | 210     |
| 1 ½               | 1.610                        | 1.500   | 260  | 380     | 210      | 290     | 170      | 240     | 130      | 190     |
| 2                 | 2.067                        | 1.939   | 220  | 320     | 170      | 250     | 140      | 200     | 110      | 160     |
| 2 ½               | 2.469                        | 2.323   | 240  | 340     | 190      | 270     | 150      | 210     | 120      | 170     |
| 3                 | 3.068                        | 2.900   | 210  | 300     | 160      | 230     | 130      | 190     | 100      | 150     |
| 3 ½               | 3.548                        | 3.364   | 190  | 280     | 150      | 220     | 120      | 170     | 90       | 140     |
| 4                 | 4.026                        | 3.826   | 180  | 260     | 140      | 200     | 110      | 160     | 90       | 130     |
| 5                 | 5.047                        | 4.813   | 160  | 230     | 120      | 180     | 100      | 140     | 80       | 120     |
| 6                 | 6.065                        | 5.761   | 140  | 220     | 110      | 170     | 90       | 140     |          | 110     |
| 8                 | 7.981                        | 7.625   | 120  | 200     | 100      | 150     | 80       | 120     |          | 100     |
| 10                | 10.020                       | 9.564   | 110  | 190     | 90       | 150     |          | 120     |          | 90      |
| 12                | 11.938                       | 11.376  | 110  | 180     | 80       | 140     |          | 110     |          | 90      |

**Table 6c**  
**Water Pressure Ratings for Schedules 40 and 80 Unthreaded Plastic Pipe: Polyethylene**

| Nominal Size (in) | Average Inside Diameter (in) |         | (PE-ASTM-D-2104 Schedule 40 Pipe)             |         |         | (PE-ASTM-D-2447 Schedule 40 and 80 Pipe)      |         |         |         |         |         |
|-------------------|------------------------------|---------|---|---------|---------|---|---------|---------|---------|---------|---------|
|                   |                              |         | Working Pressure Rating (lb/in <sup>2</sup> ) |         |         | Working Pressure Rating (lb/in <sup>2</sup> ) |         |         |         |         |         |
|                   |                              |         | PE 2306<br>3306<br>3406                       | PE 2305 | PE 1404 | PE 2306<br>3306<br>3406                       | PE 2305 |         | PE 1404 |         |         |
|                   | Sch. 40                      | Sch. 80 | Sch. 40                                       | Sch. 40 | Sch. 40 | Sch. 40                                       | Sch. 80 | Sch. 40 | Sch. 80 | Sch. 40 | Sch. 80 |
| ½                 | 0.622                        | 0.546   | 190   | 150     | 120     | 188   | 267     | 149     | 212     | 119     | 170     |
| ¾                 | .824                         | .742    | 150   | 120     | 100     | 152   | 217     | 120     | 172     | 96      | 137     |
| 1                 | 1.049                        | .957    | 140   | 110     | 90      | 142   | 199     | 113     | 158     | 90      | 126     |
| 1 ¼               | 1.380                        | 1.278   | 120   | 90      |         | 116   | 164     | 92      | 130     |         | 104     |
| 1 ½               | 1.610                        | 1.500   | 100   | 80      |         | 104   | 148     | 83      | 118     |         | 94      |
| 2                 | 2.067                        | 1.939   | 90  |         |         | 87  | 127     |         | 101     |         | 81      |
| 2 1/2             | 2.469                        | 2.323   | 100   | 80      |         | 96  | 134     |         | 106     |         | 85      |
| 3                 | 3.068                        | 2.900   | 80  |         |         | 83  | 118     |         | 94      |         |         |
| 3 ½               | 3.548                        | 3.364   |   |         |         |   | 109     |         | 86      |         |         |
| 4                 | 4.026                        | 3.826   |   |         |         |   | 102     |         | 81      |         |         |
| 5                 | 5.047                        | 4.813   |   |         |         |   | 91      |         |         |         |         |
| 6                 | 6.065                        | 5.761   |   |         |         |   | 88      |         |         |         |         |

Note: Ratings for ASTM-D-2104 Schedule pipe are based on inside diameter control; ratings for ASTM-D-2447 Schedule pipe are based on outside diameter control.

**Table 7**  
**Polyethylene and Polyvinyl Chloride Plastic Tubing**

| Nominal<br>Size<br>(in) | Outside<br>Diameter<br>(in) | Inside Diameter (in)            |         |                   |          |          |          | Pressure<br>Rating<br>(lb/in <sup>2</sup> ) |
|-------------------------|-----------------------------|---------------------------------|---------|-------------------|----------|----------|----------|---|
|                         |                             | (PE-ASTM-D-2737)                |         | (PVC-ASTM-D-2740) |          |          |          |   |
|                         |                             | PE 2306<br>3306<br>3406<br>3408 | PE 2305 | PVC 1120<br>1220  | PVC 2116 | PVC 2112 | PVC 2110 |   |
| ½                       | 0.625                       | 0.487                           | 0.453   | 0.501             | 0.501    | 0.501    | 0.501    | 160   |
| ⅝                       | .750                        | .584                            | .544    |                   |          |          |          | 160   |
| ¾                       | .875                        | .681                            | .635    | .751              | .751     | .751     | .745     | 160   |
| 1                       | 1.125                       | .875                            | .817    | 1.001             | 1.001    | .993     | .959     | 160   |
| 1 ¼                     | 1.375                       | 1.069                           | .999    | 1.251             | 1.245    | 1.213    | 1.171    | 160   |
| 1 ½                     | 1.625                       | 1.263                           | 1.159   |                   |          |          |          | 160   |
| 2                       | 2.125                       | 1.653                           | 1.543   |                   |          |          |          | 160   |

**Table 8**  
**Pressure Rating Factors for PVC and PE Pipe for Water at Elevated Temperatures**

| Temperature (°F) | PVC Factor | PE Factor |
|------------------|------------|-----------|
| 73.4             | 1.00       | 1.00      |
| 80               | .88        | .92       |
| 90               | .75        | .81       |
| 100              | .62        | .70       |
| 110              | .50        | ---       |
| 120              | .40        | ---       |
| 130              | .30        | ---       |
| 140              | .22        | ---       |

Note: To obtain the pipe's reduced pressure rating because of water temperatures above 73.4°F, multiply normal pressure rating by the appropriate factor from table.